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A key to the identification of the genera of lichenized fungi occurring in Thailand

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Abstract—A key to the identification of the 258 genera of lichenized fungi in Thailand is presented. Species names are provided for genera for which only a single species has been recorded for Thailand. Recent available keys that include all species known from Thailand are referenced. The replacement name *Ionaspis aptrootii* is proposed for *I. tropica* Aptroot (non Riddle).

Key words—biodiversity, lichens, Southeast Asia, tropics

Introduction

The lichen flora of Thailand has recently received considerable interest resulting in more than a doubling of the known species in only 15 years between a first catalogue (Wolseley & al. 2002) and a recent checklist (Buaruang & al. 2017). Moreover, several treatments of genera or species groups of lichenized fungi in East Asia or focused on Thai species have been published (cited below in the key) improving our knowledge of species diversity. Recently, numerous phylogenetic studies have dramatically changed our understanding of the evolution of lichenized fungi, with numerous taxonomic changes at the generic rank which are summarized elsewhere (Jaklitsch & al. 2016, Lücking & al. 2016a, 2017). However, only few keys to the genera of tropical lichens, especially crustose taxa, are available, providing an impediment to the training of students and making species-based treatments for scientists less accessible. For these reasons, we are providing a key to the identification of lichen genera in Thailand and notes on some genera and species previously cited in the checklist by Buaruang & al. (2017).

Notes

Some genera listed in the checklist for Thailand (Buaruang & al. 2017) have since been shown not to occur in the country and are not included in this key. These include: *Arctomia* Th. Fr.— the Thai species is now placed in *Gabura* (Magain & al. 2020); *Hemithecium* Trevis.—the Thai species are currently classified in *Graphis* (Kalb & al. 2018); *Maronina* Hafellner & R.W. Rogers—the Thai species are currently accepted in *Neoprotoparmelia* (Singh & al. 2018); and *Rostania* Trevis.—the single species recorded from Thailand is now placed in *Collema* (Kosuthova & al. 2019). *Cryptothelium sepultum* (Mont.) A. Massal. is now accepted as *Astrothelium sepultum* Mont. (Lücking & al. 2016c); and *Spilonema* Bornet does not occur in Thailand (Spribille & al. 2014), where the Thai species is now classified in *Erinacellus.* Furthermore, *Arthonia ochrodes* Nyl. ex Willey has been referred to the lichenicolous fungus *Synarthonia* Müll. Arg. However, the Thai material does not agree with the type from Cuba and requires further study (van den Broeck & al. 2018). *Blastenia* A. Massal. is not keyed out, since its presence in Thailand is doubtful, and *B. testaceorufa* (Vain.) Zahlbr. does not belong to the genus as currently circumscribed (Arup & al. 2013). "*Lobariella isidiosa* Moncada & Lücking" was listed in the checklist by error—the material belongs to *Lobaria isidiosa* (Müll. Arg.) Vain., not *Lobariella isidiata* Moncada & Lücking; the genus *Lobariella* Yoshim. does not occur in Thailand. The genus *Sulzbacheromyces,* which has been recorded from Thailand since the publication of the checklist (Suwannarach & al. 2019), is included in this key.

Key to the genera of Thai lichenized fungi

1. Thallus foliose, fruticose, dimorphic or squamulose 2
1. Thallus crustose, leprose, byssoid or filamentous 93

2. Thallus foliose or squamulose 3
2. Thallus fruticose or dimorphic 79

3. Thallus gelatinous, with cyanobacteria, homoiomerous 4
3. Thallus not gelatinous, with green algae or cyanobacteria, heteromerous 7

4. Thallus corticate,
   ascospores transversely septate to muriform . . . . *Leptogium* (Ach.) Gray
4. Thallus ecorticate, ascospores simple or transversely septate to muriform 5

5. Ascospores simple, thallus leathery, adnate, ≤10 cm wide . . . . *Physma* A. Massal.
5. Ascospores transversely septate to muriform,
   thallus tightly or loosely adnate to ±cushion-forming 6

6. Thallus foliose, lobes >3 mm wide, not squamulose or subcrustose,
   ascospores narrowly ellipsoidal to fusiform,
   transversely septate or muriform. . . . . *Collema* Weber ex F.H. Wigg.
6. Thallus smaller, when foliose then lobes <3 mm wide, squamulose, shrubby or
   crustose, ascospores transversely septate, thin-walled . . . . *Gabura* Adans.
   NOTE: One species known from Thailand: *G. fascicularis* (L.) P.M. Jørg.

7. Thallus squamulose. 8
7. Thallus foliose 24

8. Ascomata perithecia, located between squamules,
   ascospores muriform. . . . . *Agonimia* Zahlbr.
   NOTE: Recent key to the genus available (Breuss 2020).
8. Ascomata an apothecium or thallus sterile 9

9. Apothecia immersed. 10
9. Apothecia sessile to raised, or thallus sterile 11
10. Asci polyspored, ascospores simple,
   thallus containing cyanobacteria . . . . *Peltula* Nyl.
10. Asci 8-spored, ascospores 1-septate,
   thallus containing green algae . . . . *Rolfidium* Moberg
   NOTE: One species known from Thailand: *R. coccocarpioides* (Nyl.) Timdal

11. Photobiont a cyanobacterium, apothecia with a thalline margin 12
11. Photobiont a green alga, apothecia lacking a thalline margin or sterile 14

12. Thallus on a distinct blackish hypothallus. . . . . *Lepidocollema* Vain.
12. Thallus lacking a distinct hypothallus, often with lichen substances. 13

13. Thalline margin of apothecia excluded when mature,
   asci with amyloid apical structures,
   hymenium I+ red-brown. . . . . *Fuscopannaria* P.M. Jørg.
   NOTE: One species known from Thailand: *F. siamensis* P.M. Jørg. & Wolseley
13. Thalline margin of apothecia prominent and persisting when mature,
   asci without amyloid apical structures,
   hymenium I+ dark blue . . . . *Pannaria* Delise ex Bory
   NOTE: One species known from Thailand: *P. dispartita* (Nyl.) Vain.

14. Thallus consisting of small ear-like squamules, with raised margins,
   bluish grey . . . . *Normandina* Nyl.
   NOTE: One species known from Thailand: *N. pulchella* (Borrer) Nyl.
14. Thallus different. 15

15. Thallus lacking a prothallus 16
15. Thallus with a well-developed prothallus 21

16. Ascospores brown .... *Hypoflavia* Marbach
NOTE: One species known from Thailand: *H. crustosa* Aptroot
16. Ascospores hyaline, or thallus sterile 17

17. Thallus sterile and usually growing on soil or rocks 18
17. Thallus with sessile or stalked apothecia lacking a thalline margin, growing on bark or rocks 19

18. Lobes thick, greenish to greenish gray, usually >1 mm wide primary squamules of *Cladonia* spp.
18. Lobes thin, grayish blue-green to brown, <1 mm wide .... *Flakea* O.E. Erikss.
NOTE: One species known from Thailand: *F. papillata* O.E. Erikss.

19. Thallus with stalked, biatorine apothecia, ascospores simple ..... *Gymnoderma* Nyl.
NOTE: One species known from Thailand: *G. coccocarpum* Nyl.
19. Thallus with sessile, biatorine apothecia 20

20. Saxicolous, ascospores 3-septate .... *Septotrapelia* Aptroot & Chaves
20. Corticolous, ascospores 1-septate .... *Eschatogonia* Trevis.

21. Apothecia zeorine, ascospores 1–3-septate .... *Physcidia* Tuck.
21. Apothecia biatorine 22

22. Ascospores transversely septate, with up to 17 septa .... *Bacidiopsora* Kalb
22. Ascospores simple to 1-septate 23

23. Ascospores up to 20 µm long .... *Phyllopsora* Müll. Arg.
NOTE: Recent key to Asian species available (Kistenich & al. 2019).
23. Ascospores 25–40 µm long .... *Triclinum* Fée

24. Lower surface of thallus with ±rounded pores, either cyphellae or pseudocyphellae 25
24. Lower surface of thallus lacking cyphellae and pseudocyphellae 29

25. Medulla yellow, lower surface with yellow pseudocyphellae with green algal photobiont .... *Crocodia* Link
25. Medulla white, lower surface with cyphellae, cyphelloid pores, or yellow or white pseudocyphellae 26

26. Lower surface with pseudocyphellae that lack a distinct margin 27
26. Lower surface with pores with a distinct margin, with either cyphellae or cyphelloid pores 28

27. Thallus of different colors, lower surface more or less tomentose, apothecia laminal, ascospores transversely septate ...... *Pseudocyphellaria* Vain.
27. Thallus containing usnic acid, yellowish green, lower surface not tomentose, apothecia marginal, ascospores simple (green algal photobiont and no cephalodia) .... *Nephromopsis* Müll. Arg.

28. Lower surface of thallus with cyphelloid pores, thallus containing the gyrophoric acid chemosyndrome ...... *Dendriscosticta* Moncada & Lücking
28. Lower surface of thallus with distinct cyphellae, thallus lacking secondary metabolites .... *Sticta* (Schreb.) Ach.

29. Thallus yellow to yellow-orange, ascospores simple.......... *Candelaria* A. Massal.
    NOTE: One species known from Thailand: *C. concolor* (Dicks.) Arnold
29. Thallus of different colors, including yellowish green, but not yellow to yellow-orange 30

30. Lower thallus surface glossy black, erhizinate and not tomentose, lobes hollow 31
30. Lower surface of thallus of different colors, mostly rhizinate or tomentose, lobes solid 32

31. Upper surface of thallus perforated, 2–8 ascospores per ascus .... *Menegazzia* A. Massal.
    NOTE: One species known from Thailand: *M. terebrata* (Hoffm.) A. Massal.
31. Upper surface without perforations, 8 ascospores per ascus .... *Hypogymnia* (Nyl.) Nyl.

32. Thallus containing cyanobacteria as primary photobiont...................... 33
32. Thallus containing green algae as primary photobiont, cyanobacteria absent or present as secondary photobiont in cephalodia......................... 38

33. Apothecia on lower surface of thallus .... *Nephroma* Ach.
    NOTE: One species known from Thailand: *N. helveticum* Ach.
33. Apothecia laminal or marginal on upper thallus surface, or thallus sterile 34

34. Upper surface of thallus with stiff hairs, or strongly tomentose................. 35
34. Upper surface of thallus different 36

35. Thallus with stiff hairs or strongly tomentose, Pd+ yellow-orange ... *Erioderma* Fée
    NOTE: One species known from Thailand: *E. sorediatum* D.J. Galloway & P.M. Jørg.
35. Thallus strongly tomentose, lacking stiff hairs, Pd– .... *Leioderma* Nyl.
    NOTE: One species known from Thailand: *L. sorediatum* D.J. Galloway & P.M. Jørg.

36. Lower surface of thallus ecorticate, with pale to dark veins and conspicuous rhizines.. *Peltigera* Willd.
    NOTE: One species known from Thailand: *P. pindarensis* D.D. Awasthi & M. Joshi
36. Lower surface of thallus without veins.................................... 37

37. Apothecia adnate, proper margin soon becoming excluded, photobiont *Scytonema*, lower surface of thallus with dense rhizines .... *Coccocarpia* Pers.
37. Apothecia sessile, proper margin persistent, photobiont *Nostoc*, lower surface of thallus with sparse to dense rhizines .... *Lobaria* (Schreb.) Hoffm.

38. Thallus with pseudocyphellae on the upper surface 39
38. Thallus lacking pseudocyphellae on the upper surface 43

39. Thallus yellowish green, containing usnic acid. . . . . *Nephromopsis* Müll. Arg.
39. Thallus greenish gray to gray, containing atranorin. 40

40. Thallus closely appressed to the substrate by the lower cortex or inconspicuous rhizines. 41
40. Thallus loosely attached to the substrate 42

41. Thallus with distinct, linear or reticulate pseudocyphellae, lobes not fusing laterally . . . . *Pyxine* Fr.
NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2012).
41. Thallus with indistinct pseudocyphellae or pseudocyphellae lacking, lobes often fusing laterally. . . . . *Dirinaria* (Tuck.) Clem.

42. Thallus with marginal cilia, upper surface finely maculate . . . . *Parmotrema* A. Massal.
42. Thallus lacking marginal cilia, pseudocyphellae punctiform. . . . . *Cetrelia* W.L. Culb. & C.F. Culb.

43. Thallus with bulbate marginal cilia. 44
43. Thallus lacking bulbate cilia. 45

44. Thallus yellowish green, containing usnic acid. . . . . . *Relicina* (Hale & Kurok.) Hale
44. Thallus grayish green, lacking usnic acid, containing atranorin . . . . *Bulbothrix* Hale

45. Thallus yellow-green or greenish yellow to yellowish brown, containing cephalodia, with a non-trebouxioid primary photobiont 46
45. Thallus of different colors, containing a trebouxioid or non-trebouxioid photobiont, lacking cephalodia. 47

46. Thallus small-foliose, apothecia with thick thalline margin, ascospores simple, thick-walled with an epispore. . . . . *Gibbosporina* Elvebakk & al.
NOTE: One species known from Thailand: *G. boninensis* (Kurok.) Elvebakk & P.M. Jørg.
46. Thallus larger, ascospores transversely septate, thin-walled . . . .*Lobaria* (Schreb.) Hoffm.

47. Thallus containing a non-trebouxioid photobiont, lobes broad, lower surface whitish gray. . . . .*Ricasolia* De Not.
NOTE: One species known from Thailand: *R. discolor* (Bory) Nyl.
47. Thallus containing a trebouxioid photobiont, lobes and lower surface variable. 48

48. Upper surface of thallus yellow-green to greenish yellow, containing usnic acid, apothecia with a thalline margin. .49
48. Upper surface of thallus whitish, gray, olive-green or brown to blackish brown, lacking usnic acid, apothecia with or without thalline margin 54

49. Thallus with truncated lobe apices, rhizines squarrosely to dichotomously branched. . . . . *Hypotrachyna* (Vain.) Hale
49. Thallus with rounded or incised lobe apices, rhizines usually simple. 50

50. Thallus lobes broad, usually >2 mm wide 51
50. Thallus lobes narrower, <2 mm wide 52

51. Lobes apically rounded, on bark or rocks, loosely adnate,
    Thai species sorediate . . . .*Flavoparmelia* Hale
    NOTE: One species known from Thailand: *F. caperata* (L.) Hale
51. Lobes ±apically incised, on rocks,
    Thai species not sorediate . . . .*Xanthoparmelia* (Vain.) Hale

52. Thallus growing on rock. . . . .*Xanthoparmelia* (Vain.) Hale
52. Thallus growing on bark or wood. 53

53. Thallus adnate, lobes sublinear, 0.5–1.5 mm wide, sorediate,
    at high altitudes . . . . *Parmeliopsis* (Nyl.) Nyl.
    NOTE: One species known from Thailand: *P. ambigua* (Hoffm.) Nyl.
53. Thallus adnate, lobes irregular to linear-elongate, contiguous in the center,
    0.5–2 (–3) mm wide . . . . *Relicina* (Hale & Kurok.) Hale

54. Thallus with broad lobes, >5 mm wide 55
54. Thallus with narrower lobes, <5 mm wide 57

55. Thallus with cilia in lobe axils, cilia c. 0.5 mm long. . . . . . . *Parmelinella* Elix & Hale
55. Thallus eciliate or with longer cilia (0.5–6 mm long). 56

56. Thallus with a broad erhizinate margin, ciliate or eciliate,
    chemistry variable . . . . *Parmotrema* A. Massal.
56. Thallus erhizinate or with very few scattered rhizines, eciliate,
    medulla containing fatty acids . . . . *Platismatia* W.L. Culb. & C.F. Culb.
    NOTE: One species known from Thailand: *P. erosa* W.L. Culb. & C.F. Culb.

57. Thallus with cilia at margins (or marginal rhizines that resemble cilia) 58
57. Thallus eciliate 66

58. Medulla at least partly yellow to orange or orange-red 59
58. Medulla white 60

59. Thallus lobes narrow, usually less than 1 mm wide, dark gray to brownish gray,
    lacking atranorin. . . . .*Phaeophyscia* Moberg
59. Thallus lobes 2–4 mm wide, whitish gray,
    containing atranorin . . . . *Myelochroa* (Asahina) Elix & Hale

60. Thallus lacking a lower cortex 61
60. Thallus with a lower cortex 62

61. Thallus with linear-elongate, often ribbon-like, dichotomously branched lobes,
    loosely attached to the substrate . . . .*Leucodermia* Kalb
    NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2015).
61. Thallus with suborbicular lobes, attached to the substrate . . . . . *Polyblastidium* Kalb
    NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2015).

62. Thallus dark gray to brownish gray, lacking atranorin 63
62. Thallus lighter, often whitish gray, containing atranorin. 64

63. Lower cortex of thallus prosoplectenchymatous,
    lower surface white . . . . *Physciella* Essl.
    NOTE: One species known from Thailand: *P. chloantha* (Ach.) Essl.
63. Lower cortex of thallus paraplectenchymatous,
    lower surface usually dark. . . . .*Phaeophyscia* Moberg

64. Thallus lobes short, richly dichotomously branched, lower surface black,
    with short, richly dichotomously branched rhizines,
    ascospores hyaline, non-septate . . . .*Remototrachyna* Divakar & A. Crespo
64. Thallus lobes either suborbicular or orbicular to spreading irregularly,
    lower surface pale or brown, with different rhizines,
    ascospores brown, 1-septate 65

65. Upper cortex of thallus consisting of periclinal hyphae . . . . . . *Heterodermia* Trevis.
    NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2015).
65. Upper cortex of thallus paraplectenchymatous. . . . . *Physcia* (Schreb.) Michx.

66. Thallus subfoliose-peltate, monophyllous, on siliceous rocks . . . .*Rolfidium* Moberg
    NOTE: One species known from Thailand: *R. coccocarpioides* (Nyl.) Timdal
66. Thallus foliose, variable, on various substrates 67

67. Thallus closely appressed to the substrate
    by the lower cortex or inconspicuous rhizines 68
67. Thallus not as closely attached to the substrate. 70

68. Thallus very small, tightly adhered to the substrate, lacking atranorin,
    gray-green to dark brown . . . . *Hyperphyscia* Müll. Arg.
68. Thallus larger, containing atranorin, lighter, usually whitish gray 69

69. Thallus lobes not fusing laterally, often glossy . . . . *Pyxine* Fr.
    NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2012).
69. Thallus lobes often fusing laterally, matt, often pruinose . . . *Dirinaria* (Tuck.) Clem.

70. Thallus dark brown to green-brown, lacking atranorin. 71
70. Thallus lighter, mostly whitish gray to greenish gray, with or without atranorin . .72

71. Thallus small, on various substrates,
    ascospores brown, 1-septate. . . . .*Phaeophyscia* Moberg
71. Thallus larger, saxicolous,
    ascospores hyaline, non-septate . . . .*Xanthoparmelia* (Vain.) Hale

72. Thallus lacking a lower cortex. . . . . *Polyblastidium* Kalb
    NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2015).
72. Thallus with a lower cortex 73

73. Upper cortex of thallus consisting of periclinal hyphae . . . . . . *Heterodermia* Trevis.
    NOTE: Recent key to Thai species is available (Mongkolsuk & al. 2015).
73. Upper cortex of thallus not consisting of periclinal hyphae, mostly
    paraplectenchymatous 74

74. Rhizines dichotomously branched 75
74. Rhizines usually simple or squarrosely branched. 76

75. Thallus lobes broad, irregular, rotund,
irregularly branched . . . . *Remototrachyna* Divakar & A. Crespo
75. Thallus lobes narrow, sublinear to linear-elongate, truncate,
more or less dichotomously branched. . . . . *Hypotrachyna* (Vain.) Hale

76. Margin of thallus lower surface lacking rhizines at margins, lower surface
black, ascospores hyaline, non-septate . . . . *Canoparmelia* Elix & Hale
76. Lower surface of thallus lobes rhizinate to margins,
lower surface pale, ascospores various. 77

77. Lichen growing on dead wood at high altitudes, ascospores hyaline, non-septate . . . . *Imshaugia* S.L.F. Mey.
Note: One species known from Thailand: *I. placorodia* (Ach.) S.L.F. Mey.
77. Lichen growing on bark or rocks at different altitudes, ascospores brown,
1-septate 78

78. Thallus foliose, appressed but loosely adnate, irregularly concave, rounded,
upper surface bluish gray, pruinose, on rocks . . . . *Culbersonia* Essl.
Note: One species known from Thailand: *C. nubila* (Moberg) Essl.
78. Thallus foliose, suborbicular, radially lobate,
on various substrates. . . . . *Physcia* (Schreb.) Michx.

79. Thallus yellow to orange, K+ red-purple,
shrubby, sorediate. . . . . *Teloschistes* Norman
Note: One species known from Thailand: *T. flavicans* (Sw.) Norman
79. Thallus not yellow or orange, not K+ red-purple 80

80. Lichen forming clavarioid basidiomata, vegetative thallus crustose,
undifferentiated. . . . . *Sulzbacheromyces* B.P. Hodk. & Lücking
Note: One species known from Thailand: *S. yunnanensis* D. Liu & al. (Suwannarach & al. 2019).
80. Lichen forming ascomata or sterile 81

81. Lichen consisting of a basal crustose or squamulose primary thallus and an erect
secondary thallus 82
81. Lichen uniformly fruticose, lacking a primary thallus 83

82. Erect secondary thallus (podetia) hollow, lichenized, apothecia brown,
yellow or red, primary thallus squamulose to ±foliose . . . .*Cladonia* P. Browne
82. Erect part solid, not lichenized, apothecia pink to flesh-colored,
primary thallus crustose . . . . *Dibaeis* Clem.

83. Thallus containing a cyanobacterium as primary photobiont,
blue-gray to dark brown 84
83. Thallus containing a green algal primary photobiont, colors vary. 86

84. Lichenized with the cyanobacterial genus *Hyphomorpha* (trichomes with branches), thallus erect, with thread-like branches, fungal hyphae enclosing photobiont in continuous sheath, the sheathing fungal cells rectangular, no ascomata known . . . . *Erinacellus* T. Sprib. & al.

Note: One species known from Thailand: *E. schmidtii* (Vain.) T. Sprib. & al.

84. Lichenized with the cyanobacterial genera *Nostoc* or *Scytonema*, thallus shrub-like, richly branched, attached to substrate by a basal holdfast, cortex well developed, apothecia biatorine, mostly lateral, disc pale to dark brown, ascospores simple or 1-septate. 85

85. Lichenized with the cyanobacterial genus *Nostoc*, occurrence in Thailand doubtful . . . . *Polychidium* (Ach.) Gray

85. Lichenized with the cyanobacterial genus *Scytonema*. . . . .*Leptogidium* Nyl.

Note: One species known from Thailand: *L. dendriscum* (Nyl.) Nyl. (Muggia & al. 2011)

86. Thallus leprose-sorediate, ecorticate, grayish white, ascomata absent. . . . . *Lepraria* Ach.

86. Thallus not leprose-sorediate, corticate or ecorticate, colors variable. 87

87. Thallus hollow 88

87. Thallus solid or filamentous, or tufted and rather delicate 90

88. Thallus chalky white, not branched or sparingly branched, erect or decumbent, on soil at high altitudes . . . .*Thamnolia* Ach. ex Schaer.

Note: One species known from Thailand: *T. vermicularis* (Sw.) Schaer.

88. Thallus not chalky white, slightly to richly branched. 89

89. Thallus surface smooth, corticate, often glossy. . . . .*Cladia* Nyl.

Note: One species known from Thailand: *C. aggregata* (Sw.) Nyl.

89. Thallus surface rough, ecorticate . . . .*Cladonia* P. Browne

90. Thallus filamentous, small, consisting of algal filaments of *Trentepohlia* surrounded by fungal hyphae, ascospores 1-septate, hyaline . . . . *Coenogonium* Ehrenb.

Note: Recent key to Thai species available (Kalb & al. 2016a).

90. Thallus fruticose, usually larger, corticate, ascospores variable 91

91. Thallus terete with a cartilaginous axis, thallus pale green to green, or slightly reddish, often with blackened holdfast, erect to pendulous or decumbent, apothecial disc pale yellow-green. . . . . *Usnea* Dill. ex Adans.

91. Thallus flattened, without a cartilaginous axis 92

92. Thallus pale gray to pale mauve-gray, C+ red, photobiont *Trentepohlia*, on coastal trees, rare. . . . .*Roccella* DC.

Note: One species known from Thailand: *R. montagnei* Bél.

92. Thallus pale green or yellowish, C–, photobiont trebouxioid, in different habitats, locally abundant . . . .*Ramalina* Ach.

93. Thallus growing on rock, bark, wood, soil or mosses 94

93. Thallus growing on leaves 296

94. Primary photobiont blue-green, ascospores hyaline (if sterile, see 99) 95
94. Primary photobiont green, cyanobiont lacking or present in cephalodia, ascospores hyaline or brown 103

95. Ascospores transversely septate to muriform 96
95. Ascospores simple 101

96. Ascomata perithecia .... *Psoroglaena* Müll. Arg.

Note: One species known from Thailand: *P. cubensis* Müll. Arg.

96. Ascomata apothecia 97

97. Ascospores muriform, cuboid to oblong .... *Collema* Weber ex F.H. Wigg.
97. Ascospores 1-septate to transversely septate 98

98. Ascospores 1-septate, on mosses 99
98. Ascospores transversely septate, on various substrates 100

99. Lichenized with the cyanobacterial genus *Nostoc*, occurrence in Thailand doubtful .... *Polychidium* (Ach.) Gray
99. Lichenized with the cyanobacterial genus *Scytonema* .... *Leptogidium* Nyl.

Note: One species known from Thailand: *L. dendriscum* (Nyl.) Nyl. (Muggia & al. 2011).

100. Thallus gelatinous, epiphytic .... *Gabura* Adans.

Note: One species known from Thailand: *G. fascicularis* (L.) P. M. Jørg.

100. Thallus not gelatinous, on limestone .... *Placynthium* (Ach.) Gray

Note: One species known from Thailand: *P. nigrum* (Huds.) Gray

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Note: One species known from Thailand: *L. corticola* Vain.

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Note: One species known from Thailand: *L. novocaledonianum* A.L. Sm.

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Note: Recent key to species available (Ertz & al. 2011).

109. Thallus with a cortex and roundish soralia,
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109. Thallus lacking a cortex and soralia,
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Note: Recent key to the genus available (Breuss 2020).

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143. Ascospores usually over 30 µm long, often thick-walled, paraphyses usually reticulately branched, hypothecium hyaline 144

143. Ascospores usually smaller, usually thin-walled, paraphyses simple to branched, hypothecium hyaline or pigmented 147

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NOTE: One species known from Thailand: *O. africana* Vain.

144. Hymenial gel not or weakly amyloid, asci amyloid, ascospore wall 1- or 2-layered, apothecia disciform or poriform 145

145. Asci weakly amyloid, with a distinctive ocular chamber, ascospore wall mostly 2-layered, thick, apothecia disciform or poriform . . . . *Pertusaria* DC.

145. Asci strongly amyloid, no structures visible, ascospore wall 1-layered, thick or thin, apothecia disciform 146

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NOTE: One species known from Thailand: *V. velata* (Turner) I. Schmitt & Lumbsch

146. Ascospores thin-walled, lacking lecanoric acid . . . . *Lepra* Scop.

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147. Hymenium amyloid, paraphyses conglutinate 149

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149. Marginal lobes of thallus elongate, thallus subcrustose . . . . *Xanthoparmelia* (Vain.) Hale

149. Thallus crustose, without elongate lobes 150

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151. Thallus and apothecia brownish, exciple cupulate, conidia bacilliform, usually containing the alectoronic acid chemosyndrome . . . . . *Neoprotoparmelia* Garima Singh & al.

NOTE: Recent key to species available (Singh & al. 2018).

151. Thallus and apothecia not brownish, exciple annulate, conidia filiform, alectoronic acid chemosyndrome absent . . . . *Lecanora* Ach.

NOTE: Recent key to Thai species available (Papong & Lumbsch 2011).

152. Hymenium purple-violet, apothecial discs black.......... *Tephromela* M. Choisy
152. Hymenium hyaline to pale yellowish, discs of various colors, only rarely blackish brown 153

153. Conidia filiform... *Lecanora* Ach.
NOTE: Recent key to Thai species available (Papong & Lumbsch 2011).
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NOTE: One species known from Thailand: *V. flavidorufa* (Hue) Papong & Lumbsch

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NOTE: One species known from Thailand: *P. subconcolor* (Anzi) Resl & T. Sprib.
156. Thallus containing the gyrophoric acid chemosyndrome .... *Trapeliopsis* Hertel & Gotth. Schneid.
NOTE: One species known from Thailand: *T. viridescens* (Schrad.) Coppins & P. James

157. Thallus byssoid, white to pale gray, ecorticate......... *Crocynia* (Ach.) A. Massal.
NOTE: Recent key to species available (Aptroot & Cáceres 2014a).
157. Thallus crustose, not byssoid, corticate or ecorticate....................... 158

158. Thallus growing on rock.. 159
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159. Asci of the *Lecanora*-type.......................... *Ramboldia* Kantvilas & Elix
NOTE: Recent key to Thai species available (Kalb & al. 2009).
159. Asci of the *Porpidia*-type.................................... *Porpidia* Körb.
NOTE: One species known from Thailand: *P. albocaerulescens* (Wulfen) Hertel & Knoph

160. Thallus with stalked sporodochia and red pigments ... *Sprucidea* M. Cáceres & al.
NOTE: One species known from Thailand: *S. penicillata* (Aptroot & al.) M. Cáceres & al. (Cáceres & al. 2017).
160. Thallus lacking sporodochia, with or without pigment; if pigmented restricted to medulla, and yellowish to orange, not red........ 161

161. Asci without a distinct tubular structure in the tholus, thallus usually with warts .... *Malmidea* Kalb & al.
NOTE: Key to Thai species available (Kalb & al. 2011); subsequently, one additional species, *M. tratiana* Kalb & Mongk., was described (Kalb & al. 2012).
161. Asci of the *Lecanora*-type.. 162

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NOTE: Recent key to Thai species available (Kalb & al. 2009).

162. Apothecia small, under 0.5 mm in diam.,
hypothecium hyaline or pigmented 163

163. Apothecial margin entire, paraphyses unbranched, hypothecium dark brown,
ascospores thin-walled . . . . *Punctonora* Aptroot

NOTE: One species known from Thailand: *P. nigropulvinata* Aptroot

163. Apothecial margin ragged, paraphyses branched, hypothecium hyaline,
ascospores thick-walled . . . . *Traponora* Aptroot

NOTE: Recent key to species available (Aptroot 2009).

164. Ascospores polarilocular, with 2 or more locules 165

164. Ascospores transversely septate to muriform, ascospore wall various 166

165. Ascospores usually with 2 locules,
asci of *Teloschistes*-type, 8-spored . . . . *Caloplaca* Th. Fr.

165. Ascospores with more than 2 locules,
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166. Ascospores 1-septate 167

166. Ascospores with 3 or more transverse septa, or muriform 171

167. Hymenium inspersed with oil droplets, ascospores relatively thick-walled . . . . *Megalospora* Meyen

167. Hymenium clear, ascospores thick- or thin-walled 168

168. Asci with 2 ascospores, more than 40 µm long. . . . . *Lopezaria* Kalb & Hafellner

168. Asci usually with more ascospores, usually less than 40 µm long 169

169. Asci thin-walled, non-amyloid,
hamathecium weakly amyloid . . . . *Absconditella* Vězda

NOTE: One species known from Thailand: *A. delutula* (Nyl.) Coppins & H. Kilias

169. Asci with thickened apex, amyloid, hamathecium amyloid 170

170. Asci of *Catillaria*-type, paraphyses with distinct pigment caps,
ascospores <20 µm long . . . . *Catillaria* A. Massal.

170. Asci of *Lecanora*-type, paraphyses lacking distinct caps,
ascospores >20 µm long . . . . *Megalaria* Hafellner

NOTE: One species known from Thailand: *M. laureri* (Hepp ex Th. Fr.) Hafellner

171. Hymenium non-amyloid 172

171. Hymenium amyloid or hemiamyloid 173

172. Paraphyses richly branched and anastomosing . . . . *Gyalideopsis* Vězda

NOTE: Recent key to species available (Xavier-Leite & al. 2018).

172. Paraphyses simple . . . . *Gyalidea* Lettau ex Vězda

NOTE: One species known from Thailand: *G. luzonensis* (Kalb & Vězda) Aptroot & Lücking

173. Ascospores muriform 174

173. Ascospores transversely septate 176

174. Apothecia K–, lacking anthraquinones .... *Phlyctis* (Wallr.) Flot.
174. Apothecia K+ violet, containing anthraquinones.......... 175

175. Thallus whitish or gray, lacking anthraquinones, asci 1 (–2)-spored .... *Brigantiaea* Trevis.
175. Thallus yellowish, containing anthraquinones, asci 2–8-spored .... *Letrouitia* Hafellner & Bellem.

176. Apothecia lecanorine or immersed in verrucae 177
176. Apothecia biatorine or lecideine.......... 179

177. Apothecia lecanorine, discs red, K+ red, ascospores thin-walled..........*Haematomma* A. Massal.
177. Apothecia immersed in verrucae, discs not pigmented 178

178. Paraphyses simple to apically sparingly branched, asci with weakly amyloid tholus, ascospores thick-walled, containing depsidones .... *Phlyctis* (Wallr.) Flot.
178. Paraphyses slightly branched, asci with an amyloid tholus, ascospores relatively thin-walled, spiraled, containing depsides....... *Loxospora* A. Massal.
Note: One species known from Thailand: *L. lecanoriformis* Lumbsch & al.

179. Exciple poorly developed, consisting of paraphysis-like hyphae, asci of *Lecanora*-type, ascospores twisted .... *Scoliciosporum* A. Massal.
Note: One species known from Thailand: *S. umbrinum* (Ach.) Lojka
179. Exciple well developed, ascospores and asci variable.......... 182

180. Thallus with stalked soralia, ascospores 1–3-septate ...... *Crustospathula* Aptroot
Note: One species known from Thailand: *C. khaoyaiana* Kalb & Mongk.
180. Thallus lacking stalked soralia.......... 181

181. Asci of *Catillaria*-type, hypothecium dark, thallus containing depsidones ....*Kalbionora* Sodamuk & al.
Note: One species known: *K. palaeotropica* Sodamuk & al.
181. Asci of *Bacidia*-type, hypothecium hyaline to pigmented, chemistry variable..........*Bacidia* De Not.

182. Mazaedium present, asci prototunicate, ascospores brown 183
182. Mazaedium absent, asci uni- or bitunicate, ascospores hyaline or brown 188

183. Ascospores 2-septate to submuriform.......... 184
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184. Ascospores 2-septate, secondary metabolites lacking ...... *Heterocyphelium* Vain.
Note: One species known from Thailand: *H. leucampyx* (Tuck.) Vain.
184. Ascospores 3-septate to submuriform.......... 185

185. Ascospores 3-septate .... *Pyrgillus* Nyl.
Note: Recent key to species available (Singh & Singh 2017).
185. Ascospores submuriform, containing norstictic acid ....*Schistophoron* Stirt.
Note: One species known from Thailand: *S. tenue* Stirt.

186. Exciple edge with a pale corona .... *Nadvornikia* Tibell
186. Exciple edge without a corona........ 187

187. Apothecia with a thick,
whitish gray thalline margin........ *Tylophoron* Nyl. ex Stizenb.
Note: Recent key to species available (Ertz & al. 2011).
187. Apothecia without a thalline margin........ *Pyrgillus* Nyl.
Note: Recent key to species available (Singh and Singh 2017).

188. Apothecia orbicular or not well defined 189
188. Apothecia lirellate........ 231

189. Paraphyses simple, hymenium amyloid or not, asci cylindrical, unitunicate,
ascomata orbicular, urceolate, apothecioid or perithecioid 190
189. Paraphyses more or less branched and often anastomosing, rarely simple,
hymenium non-amyloid, asci non-amyloid or with a small amyloid plug,
bitunicate, ascomata various........ 223

190. Ascospores thin-walled, non-septate or septate
and with more or less angular lumina........ 191
190. Ascospores mostly thick-walled, transversely septate or muriform,
with lenticular or diamond-shaped lumina 200

191. Ascospores non-septate, apothecia immersed in the thallus ...... *Ionaspis* Th. Fr.
Note: One species known from Thailand: ***Ionaspis aptrootii*** Poengs. & Lumbsch,
nom. nov., MB 835127; ≡ *Ionaspis tropica* Aptroot, Biblioth. Lichenol. 64: 73. 1997,
nom. illeg., non *Ionaspis tropica* Riddle (Britton & Millspaugh 1920).
191. Ascospores transversely septate to muriform........ 192

192. Proper exciple and hypothecium carbonaceous,
epihymenium brown-granular........ *Glyphis* Ach.
Note: Recent key to species available (Staiger 2002).
192. Proper exciple and hypothecium not carbonaceous,
epihymenium not brown-granular........ 193

193. Disc of mature apothecia plane and adnate,
or plane to convex and apothecia sessile........ 194
193. Disc of mature apothecia urceolate, or apothecia perithecioid 198

194. Apothecia pale yellow, sessile, biatorine, proper exciple hyaline to yellowish,
pseudoparenchymatous, ascospores 1-septate .... *Coenogonium* Ehrenb.
Note: Recent key to Thai species available (Kalb & al. 2016a).
194. Apothecia immersed but erumpent, opening by radial or tangential fissures,
margins grayish, formed by exfoliating recurved triangular lobes 195

195. Thallus ecorticate or partly corticate, matt 196
195. Thallus densely corticate, usually shiny........ 197

196. Exciple more or less brown, ascospores amyloid .....*Pseudochapsa* Parnmen & al.
196. Exciple hyaline to yellowish, ascospores non-amyloid ....*Chapsa* A. Massal.

197. Apothecia with recurved margins,
ascospores non-amyloid . . . . *Astrochapsa* Parnmen & al.
NOTE: Recent key to species available (Borgato & Ertz 2018).

197. Apothecial margins not or slightly recurved,
with striate exciple filling the disc . . . . *Pseudotopeliopsis* Parnmen & al.
NOTE: One species known from Thailand: *P. laceratula* Müll ArgParnmen & al.

198. Exciple indistinct,
periphysoids lacking. . . . . *Gyalecta* Ach. [= *Cryptolechia* A. Massal.]

198. Exciple well developed, with periphysoids 199

199. Thallus indistinct, apothecia immersed to erumpent, asci thin-walled throughout,
ascospores 1-septate to muriform . . . . *Ramonia* Stizenb.
NOTE: One species known from Thailand: *R. minima* J. Kalb & Kalb (Kalb & Kalb 2017).

199. Thallus thin, gray to olive-gray, apothecia sessile to subimmersed, asci thin-walled, with a thickened apex, ascospores transversely septate (to muriform). . . . . *Topeliopsis* Kantvilas & Vězda
NOTE: One species known from Thailand: *T. darlingtonii* Frisch & Kalb

200. Exciple with periphysoids or apical fibrils. 201

200. Exciple lacking periphysoids and apical fibrils 210

201. Exciple with apical fibrils consisting of radiating hyphae around the pore,
periphysoids absent . . . . *Fibrillithecis* Frisch
NOTE: One species known from Thailand: *F. argentea* (Müll. Arg.) Rivas Plata & Lücking

201. Exciple lacking apical fibrils but with periphysoids
separating the hymenium and exciple 202

202. Apothecia with a more or less free exciple and
a split between exciple and thalline margin 203

202. Apothecia with a more or less fused exciple and
lacking a distinct split between exciple and thalline margin 205

203. Thallus ecorticate or with a loose cortex, if with dense cortex
then lacking stictic acid . . . . *Thelotrema* Ach.
NOTE: Recent key to species available (Rivas Plata & al. 2010).

203. Thallus with a dense cortex, ascospores ≤60 µm long,
with stictic acid 204

204. Apothecia large, >0.3 mm in diam., erumpent to prominent, with a thick, often fissured, thalline margin, periphysoids distinct . . . . *Asteristion* Leight.
NOTE: One species known from Thailand: *A. alboannuliforme* (Nagarkar & al.) I. Medeiros & al.

204. Apothecia smaller, ≤0.3 mm in diam., immersed-erumpent, with a thin, entire thalline margin, periphysoids indistinct . . . . *Austrotrema* I. Medeiros & al.
NOTE: One species known from Thailand: *A. terebrans* (Nyl.) I. Medeiros & al.

205. Apothecial discs more or less concealed by the incurved, denticulate margins,
paraphyses apically not distinctly thickened....... *Topeliopsis* Kantvilas & Vězda
Note: One species known from Thailand: *T. darlingtonii* Frisch & Kalb

205. Apothecial discs more or less exposed,
paraphyses often apically thickened and moniliform 206

206. Apothecia with a free exciple and distinct double margin,
thallus with a dense cortex, containing stictic acid ....*Asteristion* Leight.
Note: One species known from Thailand: *A. alboannuliforme* (Nagarkar & al.) I. Medeiros & al.

206. Apothecia with a fused exciple, cortex and chemistry variable 207

207. Thallus densely corticate, usually shiny................................. 208

207. Thallus ecorticate or partly corticate, matt 209

208. Apothecia with recurved margins, ascospores brown,
amyloid..................................... *Nitidochapsa* Parnmen & al.
Note: Recent key to species available (Poengsungnoen & al. 2014).

208. Apothecial margins not or slightly recurved, with striate exciple filling the
disc ....*Pseudotopeliopsis* Parnmen & al.
Note: one species known from Thailand: *P. laceratula* (Müll. Arg.) Parnmen & al.

209. Exciple more or less brown, ascospores amyloid .....*Pseudochapsa* Parnmen & al.

209. Exciple hyaline to yellowish, ascospores non-amyloid ....*Chapsa* A. Massal.
Note: Recent key to species available (Rivas Plata & al. 2010).

210. Apothecia solitary, lacking a columella 211

210. Apothecia solitary or pseudostromatic, with a columella or
columella-like sterile tissue in the hymenium 217

211. Apothecia with the covering lobules rupturing radially and horizontally,
medulla dark red, exciple more or less carbonized,
ascospores diamond-shaped.................. *Cruentotrema* Rivas Plata & al.
Note: Recent key to species available (Kalb & Schumm 2021).

211. Apothecia different, medulla pigmented or not, exciple hyaline or brown,
ascospores not diamond-shaped 212

212. Apothecia emergent to sessile, hymenium inspersed or rarely clear,
exciple carbonized 213

212. Apothecia immersed to sessile, hymenium mostly clear, rarely inspersed,
exciple hyaline to brownish... 214

213. Apothecia with a yellow to orange disc, hymenium inspersed with small oil
droplets, ascospores ellipsoid to broadly ellipsoid,
containing protocetraric acid ....*Ampliotrema* Kalb

213. Apothecia lacking pigments, hymenium clear or inspersed,
ascospores narrowly fusiform to cylindrical,
lacking secondary metabolites .... *Trinathotrema* Lücking & al.
Note: Recent key to species available (Kalb & Kalb 2017).

214. Apothecia immersed, exciple prosoplectenchymatous,
chemistry variable but psoromic acid common . . . . *Myriotrema* Fée

Note: Recent key to species available (Lücking & al. 2016b).

214. Apothecia immersed to sessile, exciple paraplectenchymatous,
chemistry variable but psoromic acid absent and stictic acid common 215

215. Apothecia immersed with a pore-like opening,
ascospores hyaline, non-amyloid,
thallus with prosoplectenchymatous cortex . . . . . . *Wirthiotrema* Rivas Plata & al.

215. Apothecia immersed to sessile, with a broader opening,
ascospores brown, rarely hyaline, non- or weakly amyloid,
thallus ecorticate or with a weakly developed cortex. 216

216. Young ascospores thick-walled, thallus loosely attached to substrate,
with large clusters of columnar crystals,
medulla with red crystals . . . . *Sanguinotrema* Lücking

Note: One species known from Thailand: *S. wightii* (Taylor) Lücking.

216. Young ascospores thin-walled, thallus firmly attached to the substrate,
with irregularly dispersed crystals,
medulla lacking red crystals. . . . . *Leucodecton* A. Massal.

217. Ascospores diamond-shaped, non-amyloid,
exciple carbonized . . . . *Clandestinotrema* Rivas Plata & al.

Note: One species known from Thailand: *C. clandestinum* (Ach.) Rivas Plata & al.

217. Ascospores not diamond-shaped, amyloid or non-amyloid,
exciple hyaline to carbonized 218

218. Columella broad-based, carbonized,
thallus ecorticate or with weakly developed cortex . . . . *Melanotrema* Frisch

218. Columella smaller when simple or reticulate, or pseudocolumella present, or
apothecia pseudostromatic, thallus with a well-developed cortex. 219

219. Apothecia pseudostromatic, columella absent . . . . *Compositrema* Rivas Plata & al.

Note: One species known from Thailand: *C. thailandicum* Rivas Plata & al.

219. Apothecia solitary, columella present 220

220. Columella reticulate 221

220. Columella simple or a pseudocolumella
(not penetrating the hymenium completely) present 222

221. Apothecia uncarbonized or weakly carbonized, margins thick,
discs usually pruinose . . . . *Stegobolus* Mont.

Note: One species known from Thailand: *S. berkeleyanus* Mont.

221. Apothecia distinctly carbonized, margins thin,
discs mostly epruinose. . . . . *Rhabdodiscus* Vain.

222. Exciple hyaline, pseudocolumella present,
ascospores relatively small. . . . . *Glaucotrema* Rivas Plata & Lumbsch

Note: Recent key to species available (Lücking & al. 2016b).

222. Exciple hyaline to carbonized, columella present,
ascospores of various sizes. . . . . *Ocellularia* G. Mey.
NOTE: Recent key to Thai species available (Sutjaritturakan & Kalb 2015).

223. Ascomata not well defined, asci weakly aggregated in clusters or scattered, broadly clavate 224
223. Ascomata present, orbicular, asci clavate or cylindrical, ascospores various . . . 225

224. Ascospores muriform. . . . . *Cryptothecia* Stirt.
224. Ascospores transversely septate . . . . *Stirtonia* A.L. Sm.
NOTE: One species known from Thailand: *S. rhizophorae* Kalb & Mongk.

225. Paraphyses weakly anastomosing, paraphyses easily separated in KOH. 226
225. Paraphyses strongly anastomosing, paraphyses conglutinate in KOH 227

226. Ascomata lecideine, paraphyses weakly anastomosing,
ascospores multi-septate, acicular,
sometimes separating into part-spores in the ascus . . . . . . *Bactrospora* A. Massal.
NOTE: Recent key to species available (Sobreira & al. 2015)
226. Ascomata with pseudothalline margin, paraphyses simple,
ascospores not separating into part-spores. . . . . *Graphidastra* (Redinger) G. Thor

227. Thallus byssoid . . . . *Dichosporidium* Pat.
NOTE: One species known from Thailand: *D. boschianum* (Mont.) G. Thor
227. Thallus crustose. 228

228. Ascomata perithecioid, in stromata . . . . *Chiodecton* Ach.
NOTE: Key to species available (Thor 1990).
228. Ascomata apothecioid, not in stromata. 229

229. Exciple containing crystals, asci clavate, apothecial discs often
pruinose . . . . *Cresponea* Egea & Torrente
NOTE: Recent key to species available (Egea & Torrente 1993).
229. Exciple lacking crystals 230

230. Ascomata orbicular, asci of *abietina*-type,
ascospores fusiform . . . . *Lecanactis* Körb..
230. Ascomata somewhat rounded to lirellate, asci of *grumulosa*-type,
ascospores ellipsoidal to fusiform. . . . . *Lecanographa* Egea & Torrente
NOTE: One species known from Thailand: *L. atropunctata* Sparrius & al.

231. Asci bitunicate, with a small amyloid plug, clavate to cylindrical 232
231. Asci unitunicate, non-amyloid, cylindrical, unitunicate. 239

232. Ascomata stromatoid 233
232. Ascomata solitary, not in stromata. 234

233. Apothecial discs exposed in stomata . . . . *Syncesia* Taylor
NOTE: One species known from Thailand: *S. albiseda* (Nyl.) Tehler
233. Apothecial discs in stromata perithecioid. *Chiodecton* Ach.
NOTE: Recent key to species available (Thor 1990).

234. Ascomatal margins indistinct, asci broadly clavate 235
234. Ascomatal margins distinct, asci cylindrical to clavate 236

235. Ascospores transversely septate . . . . *Arthonia* Ach.
235. Ascospores muriform . . . . *Arthothelium* A. Massal.

236. Ascomata with a pseudothalline margin, orbicular to slightly lirellate, ascospores biclavate . . . . *Graphidastra* (Redinger) G. Thor
236. Ascomata without a pseudothalline margin, lirellate, ascospores various 237

237. Ascomata immersed in thallus, exciple and hypothecium hyaline. . . . . *Enterographa* Fée
Note: Recent key to species available (Seavey & Seavey 2014).
237. Ascomata sessile, exciple and/or hypothecium pigmented. 238

238. Ascomata ellipsoid to shortly lirelliform, asci cylindrical, without apical thickening . . . . *Lecanographa* Egea & Torrente
Note: One species known from Thailand: *L. atropunctata* Sparrius & al.
238. Ascomata lirelliform, asci clavate to cylindrical, apically thickened . . . . *Opegrapha* Ach.

239. Ascospores hyaline 240
239. Ascospores becoming brown. 248

240. Exciple not carbonized. 241
240. Exciple, at least partly carbonized. 245

241. Paraphyses with warted tips . . . . *Acanthothecis* Clem.
Note: One species known from Thailand: *A. yokdonensis* S. Joshi & Hur
241. Paraphyses lacking warted tips 242

242. Lirellae narrow, more or less immersed in thallus, discs partly covered by the thallus . . . . *Fissurina* Fée
242. Ascomata different 243

243. Ascospores small, less than 20 µm long. . . . . *Platythecium* Staiger
Note: Recent key to species available (Neuwirth & al. 2017).
243. Ascospores larger 244

244. Thallus ecorticate, whitish gray, discs whitish-pruinose . . . . *Diorygma* Eschw.
244. Thallus corticate, discs various.. . . . . *Allographa* Chevall.
Note: Recent key to Thai species available (Kalb & al. 2018).

245. Apothecial discs brown-pruinose. . . . . *Glyphis* Ach.
Note: Recent key to species available (Staiger 2002).
245. Apothecial discs epruinose or with whitish or yellowish pruina 246

246. Thallus containing lecanoric acid, C+ red, apothecial discs heavily whitish-pruinose . . . . *Dyplolabia* A. Massal.
Note: Recent key to species available (Kalb & al. 2016b).
246. Thallus lacking substance or containing other substances, apothecial discs epruinose or pruinose 247

247. Periphysoids warty, labia covered by whitish pruina,
ascospores non- or weakly amyloid . . . . *Carbacanthographis* Staiger & Kalb
Note: Recent key to species available (Staiger 2002)

247. Periphysoids not warty, labia exposed or partly covered by thallus,
ascospores strongly amyloid . . . .*Allographa* Chevall. & *Graphis* Adans.
Note: Recent key to Thai species available (Kalb & al. 2018).

248. Ascomata not carbonized 249
248. Ascomata at least partly carbonized. 252

249. Ascospores non-amyloid, walls not thickened . . . . *Phaeographopsis* Sipman
Note: Recent key to species available (Kalb & Kalb 2017).
249. Ascospores amyloid or non-amyloid, walls thickened 250

250. Ascomata stromatoid . . . . *Creographa* A. Massal.
Note: One species known from Thailand: *C. subbrasiliensis* Sutjaritt. & Kalb
250. Ascomata not in stromata 251

251. Ascomata with distinct labiae covering the apothecial discs
. . . .*Pallidogramme* Staiger & al.
251. Ascomata with indistinct labiae and exposed apothecial discs
. . . . *Phaeographis* Müll. Arg. [= *Gymnographa* Müll. Arg.]

252. Ascomata stromatoid . . . . *Sarcographa* Fée
252. Ascomata not in stromata 253

253. Hypothecium not carbonized, exciple carbonized. . . . .*Platygramme* Fée
Note: Recent key to Thai species available (Kalb & Kalb 2017).
253. Hypothecium carbonized 254

254. Labiae indistinct, ascospores transversely septate . . . . *Leiorreuma* Eschw.
254. Labiae distinct, ascospores muriform 255

255. Apothecial discs pruinose, hymenium not red. . . . .*Thecaria* Fée
Note: One species known from Thailand: *T. quassiicola* Fée
255. Apothecial discs epruinose, hymenium dark red. . . . . *Pliariona* A. Massal.
Note: One species known from Thailand: *P. montagnei* (Bosch) A. Massal.

256. Ascospores non-septate, hyaline. 257
256. Ascospores septate, hyaline or brown 260

257. Paraphyses present, periphyses absent,
ascospores over 30 µm long, thick-walled. . . . .*Pertusaria* DC.
257. Paraphyses absent, periphyses present,
ascospores variable 258

258. Ascospores over 30 µm long, thick-walled, on bark . . . . *Coccotrema* Müll. Arg.
258. Ascospores smaller, thin-walled, on rocks 259

259. Thallus endolithic, perithecial involucrellum with star-shaped aperture, perithecia immersed. . . . . *Bagliettoa* A. Massal.

NOTE: One species known from Thailand: *B. baldensis* (A. Massal.) Vězda

259. Thallus epi- or endolithic, perithecial involucrellum lacking star-shaped aperture, perithecia sessile or rarely immersed. . . . . *Verrucaria* Schrad.

NOTE: One species known from Thailand: *V. muralis* Ach.

260. Mazaedium present, asci prototunicate, ascospores brown 261

260. Mazaedium absent, asci uni- or bitunicate, ascospores hyaline or brown 262

261. Ascomata with poriform opening disc, photobiont trebouxioid . . . *Pyrgidium* Nyl.

NOTE: One species known from Thailand: *P. montellicum* (Beltr.) Tibell

261. Ascomata with widely exposed disc, photobiont *Trentepohlia*. . . . . . . *Pyrgillus* Nyl.

NOTE: Recent key to species available (Singh & Singh 2017).

262. Paraphyses or other interascal hyphae absent, ascospores muriform 263

262. Paraphyses or other interascal hyphae present, ascospores various. 264

263. Hymenium lacking algae, usually on bark . . . . *Agonimia* Zahlbr.

NOTE: Recent key to the genus available (Breuss 2020).

263. Hymenium with algae, on soil and calcareous rocks. . . . . *Endocarpon* Hedw.

264. Ascospores brown. 265

264. Ascospores hyaline 273

265. Asci unitunicate, paraphyses simple to sparingly branched, periphysoids, if present, going down to the hymenium 266

265. Asci bitunicate, paraphyses simple to strongly branched and anastomosing, periphysoids, if present, restricted to ostiole 267

266. Photobiont trebouxioid, on soil or rocks. . . . .*Diploschistes* Norman

NOTE: Recent key to species available (Rivas Plata & al. 2010).

266. Photobiont trentepohlioid, on various substrates . . . . Genera with perithecioid apothecia – see 188

267. Paraphyses simple. 268

267. Paraphyses strongly branched and anastomosing 272

268. Ascomata stromatoid 269

268. Ascomata solitary 270

269. Asci broadly clavate, thick-walled, ascospores muriform . . . . *Mycoporum* Flot. ex Nyl.

NOTE: One species known from Thailand: *M. compositum* (A. Massal.) R.C. Harris

269. Asci cylindrical to clavate, only apically thickened, ascospores transversely septate to muriform . . . . *Pyrenula* Ach.

NOTE: Recent key to species available (Aptroot 2012).

270. Ascospores red-brown with rounded lumina. . . . . *Lithothelium* Müll. Arg.

NOTE: Recent key to species available (Aptroot 2006).

270. Ascospores gray to brown, not red-brown 271

271. Ascospores distoseptate, transversely septate to muriform. . . . . *Pyrenula* Ach.
NOTE: Recent key to species available (Aptroot 2012).
271. Ascospores euseptate, muriform. . . . . *Anthracothecium* Hampe ex A. Massal.
NOTE: Recent key to species available (Aptroot 2012).

272. Ascospores small (less than 20 µm long), ascomata exposed, black . . . . *Bogoriella* Zahlbr.
NOTE: Recent key to species available (Aptroot & Lücking 2016).
272. Ascospores larger, ascomata covered at least in part by the thallus . . . . *Architrypethelium* Aptroot
NOTE: One species known from Thailand: *A. murisporum* Luangsuph. & al.

273. Asci unitunicate. 274
273. Asci bitunicate 277

274. Photobiont trebouxioid, asci thick-walled. . . . . *Aspidothelium* Vain.
274. Photobiont trentepohlioid, asci thin- or thick-walled 275

275. Asci thick-walled, periphysoids, if present, going down to the hymenium . . . . Genera with perithecioid apothecia – see 189
275. Asci thin-walled, apically with refractive ring 276

276. Thallus and ascomata lacking yellow to orange pigments, ascospores transversely septate to muriform . . . . *Porina* Ach.
276. Thallus and ascomata containing yellow to orange pigments (phenalenones), ascospores muriform . . . . *Myeloconis* P.M. McCarthy & Elix
NOTE: One species known from Thailand: *M. erumpens* P.M. McCarthy & Elix

277. Paraphyses simple 278
277. Paraphyses strongly branched and anastomosing or hamathecium pseudoparenchymatous 279

278. Ascomata stromatoid, ascospores muriform . . . . *Mycoporum* Flot. ex Nyl.
NOTE: One species known from Thailand: *M. compositum* (A. Massal.) R.C. Harris
278. Ascomata solitary, ascospores transversely septate to submuriform. . . . *Strigula* Fr.

279. Hamathecium pseudoparenchymatous . . . . *Tomasellia* A. Massal.
NOTE: One species known from Thailand: *T. eschweileri* (Müll. Arg.) R.C. Harris
279. Hamathecium consisting of strongly branched and anastomosing paraphyses. 280

280. Ascospores 1-septate 281
280. Ascospores transversely septate to muriform 282

281. Ascospores small to medium-sized (up to 50µm long), with thin walls and septa, thallus usually thin . . . . *Anisomeridium* (Müll. Arg.) M. Choisy
281. Ascospores large (above 50µm long), with thick walls and septa, thallus thick . . . . *Megalotremis* Aptroot

282. Ascospores filiform, transversely septate. . . . . *Celothelium* A. Massal.
NOTE: One species known from Thailand: *C. aciculiferum* (Nyl.) Vain.
282. Ascospores fusiform to ellipsoid, transversely septate to muriform 283

283. Ascospores euseptate, muriform. . . . . *Julella* Fabre
   NOTE: One species known from Thailand: *J. lactea* (A. Massal.) M.E. Barr

283. Ascospores distoseptate, transversely septate to muriform. 284

284. Paraphyses simple . . . . *Lithothelium* Müll. Arg.
   NOTE: Recent key to species available (Aptroot 2006).

284. Paraphyses strongly branched and anastomosing 285

285. Thallus ecorticate, ascomata exposed, dark-pigmented 286

285. Thallus corticate, ascomata at least in part covered by thallus 288

286. Paraphyses basally thickened, not anastomosing . . *Constrictolumina* Lücking & al.
   NOTE: One species known from Thailand: *C. cinchonae* (Ach.) Lücking & al.

286. Paraphyses thickness uniform, anastomosing 287

287. Ascospore lumina angular,
   endospore thin. . . . . *Polymeridium* (Müll. Arg.) R.C. Harris
   NOTE: Recent key to species available (Aptroot & Cáceres 2014b).

287. Ascospores with diamond-shaped lumina,
   endospore thick. . . . . *Pseudopyrenula* Müll. Arg.

288. Ascospores with rectangular to oval lumina, transversely septate. 289

288. Ascospores with diamond-shaped lumina, transversely septate to muriform . . 291

289. Ascomata in brown-black, sessile stromata,
   ascospores 3–9-septate, up to 40 μm long. . . . . *Bathelium* Ach.
   NOTE: Recent key to species available (Aptroot & Lücking 2016).

289. Ascomata in variously colored stromata or solitary,
   ascospores (5–)9–19-septate, over 40 μm long. 290

290. Ascomata immersed-erumpent, solitary to aggregated,
   pigments absent. . . . . *Viridothelium* Lücking & al.
   NOTE: One species known from Thailand: *V. virens* (Tuck. ex Michener) Lücking & al.

290. Ascomata in erumpent to prominent pseudostromata,
   often pigmented. . . . . *Trypethelium* Spreng.
   NOTE: Recent key to species available (Aptroot & Lücking 2016).

291. Ascospores transversely septate 292

291. Ascospores muriform. 294

292. Ascospores very large, 3(–5)-septate, with a reduced
   endospore. . . . .*Architrypethelium* Aptroot
   NOTE: One species known from Thailand: *A. murisporum* Luangsuph. & al.

292. Ascospores usually small to medium-sized. 293

293. Ascomata prominent to sessile, fully exposed and black, solitary, lacking
   pigments. . . . . *Nigrovothelium* Lücking & al.
   NOTE: One species known from Thailand: *N. tropicum* (Ach.) Lücking & al.

293. Ascomata immersed to prominent or in immersed to sessile stromata,
at least partly covered by thallus,
often with yellow-orange pigment........................ *Astrothelium* Eschw.

294. Ascomata in prominent stromata
filled with yellow-orange pigments.......................... *Bathelium* Ach.
Note: Recent key to species available (Aptroot & Lücking 2016).

294. Ascomata immersed to sessile or in immersed to sessile stromata, at least partly
covered by thallus, with or without pigments........................... 295

295. Ascomata in large, prominent to sessile stromata,
red or yellow-orange warts .... *Marcelaria* Aptroot & al.
Note: Recent key to species available (Aptroot & Lücking 2016).

295. Ascomata immersed to prominent or in immersed to sessile stromata,
lacking pigments or with a thin pigment layer
......................*Astrothelium* Eschw. & *Viridothelium* Lücking & al.
Note: Recent key to species available (Aptroot & Lücking 2016).

296. Ascomata not well defined, asci weakly aggregated in clusters or
scattered, broadly clavate, ascospores muriform ....*Cryptothecia* Stirt.

296. Ascomata well defined, either apothecia or perithecia 297

297. Ascomata with open discs (apothecia)................................. 298

297. Ascomata opening with a small pore (perithecia) 329

298. Apothecia lirellate... 299

298. Apothecia orbicular 303

299. Apothecial margin carbonized, lacking algae........................... 300

299. Apothecial margin not carbonized, containing algae 301

300. Photobiont trentepohlioid, asci bitunicate ....*Opegrapha* Ach.

300. Photobiont chlorococcoid, asci unitunicate .... *Aulaxina* Fée
Note: Recent key to species available (Lücking 2008).

301. Ascospores muriform..............................*Gyalectidium* Müll. Arg.

301. Ascospores transversely septate 302

302. Apothecial margin well-developed, ascospores 3–15-septate.....*Enterographa* Fée
Note: Recent key to species available (Seavey & Seavey 2014).

302. Apothecial margin reduced, ascospores 1–2-septate.............. *Arthonia* Ach.

303. Photobiont trentepohlioid.. 304

303. Photobiont chlorococcoid.. 307

304. Ascomata adnate and spot-like,
asci obovate to globose, bitunicate................ *Eremothecella* Syd. & P. Syd.
Note: Recent key to species available (Jagadesh Ram & Sinha 2019).

304. Ascomata immersed to erumpent or sessile,
asci cylindrical to clavate, uni- or bitunicate........................... 305

305. Apothecial discs dark gray to black, asci bitunicate,
paraphyses anastomosing . . . . *Mazosia* A. Massal.
NOTE: Recent key to species available (Lücking 2008).

305. Apothecial discs yellowish green, light gray or orange-red, asci unitunicate,
paraphyses not anastomosing 306

306. Apothecial margins recurved, prominent,
ascospores transversely septate to muriform . *Chroodiscus* (Müll. Arg.) Müll. Arg.
NOTE: Recent key to species available (Papong & al. 2009).

306. Apothecia biatorine, margins not recurved,
ascospores 1-septate . . . . *Coenogonium* Ehrenb.
NOTE: Recent key to Thai species available (Kalb & al. 2016a).

307. Hymenium non-amyloid 308

307. Hymenium amyloid 318

308. Thallus corticate 309

308. Thallus ecorticate 310

309. Apothecia pale yellowish, exciple hyaline . . . . *Asterothyrium* Müll. Arg.
NOTE: Recent key to species available (Lücking 2008).

309. Apothecia black, exciple at least partly carbonized . . . . *Psorotheciopsis* Rehm
NOTE: One species known from Thailand: *P. patellarioides* (Rehm) R. Sant.

310. Sterile setae present. 311

310. Sterile setae absent but hyphophores often present 312

311. Sterile setae pale . . . . *Aderkomyces* Bat.

311. Sterile setae black . . . . *Tricharia* Fée

312. Apothecial margin dark brown to black, exciple carbonized . . . . *Aulaxina* Fée
NOTE: Recent key to species available (Lücking 2008).

312. Apothecial margin pale, exciple not carbonized. 313

313. Proper exciple well-developed, covered by a cartilaginous layer 314

313. Proper exciple reduced, with a thalline margin or immersed in thallus 315

314. Paraphyses unbranched, hyphophores absent . . *Phyllogyalidea* Lücking & Aptroot
NOTE: One species known from Thailand: *P. epiphylla* (Vězda) Lücking & Aptroot

314. Paraphyses branched, hyphophores common. . . . . *Gyalideopsis* Vězda
NOTE: Recent key to species available (Xavier-Leite & al. 2018).

315. Hyphophores squamiform, ascospores muriform . . . . *Gyalectidium* Müll. Arg.

315. Hyphophores setiform 316

316. Apothecia adnate. . . . . *Echinoplaca* Fée
NOTE: Recent key to species available (Lücking 2008).

316. Apothecia immersed-erumpent 317

317. Hyphophores pale,
ascospores transversely septate to muriform .... *Calenia* Müll. Arg.
317. Hyphophores reddish brown,
ascospores 1–3-septate ....*Rolueckia* Papong & al.
Note: One species known from Thailand: *R. siamensis* Papong & al.

318. Ascospores 1-septate ....*Fellhanera* Vězda
318. Ascospores with more than 1 septum 319

319. Ascospores transversely septate 320
319. Ascospores muriform.. 328

320. Ascospores narrowly cylindrical to filiform .... *Bacidina* Vězda
Note: One species known from Thailand: *B. pallidocarnea* (Müll. Arg.) Vězda
320. Ascospores ellipsoid to cylindrical..................................... 321

321. Apothecial margin composed of loosely interwoven hyphae.... *Byssoloma* Trevis.
321. Apothecial margin different 322

322. Exciple with crystals.. 323
322. Exciple lacking crystals 325

323. Conidia produced in campylidia .... *Badimia* Vězda
Note: One species known from Thailand: *B. multiseptata* Papong & Lücking
323. Conidia produced in pycnidia... 324

324. Apothecial margin distinct, whitish, conidia ellipsoid-
fusiform ....*Eugeniella* Lücking & al.
Note: One species known from Thailand: *E. micrommata* (Kremp.) Lücking & al.
324. Apothecial margin thin, gray, conidia pyriform...............*Fellhanera* Vězda

325. Conidia produced in pycnidia... 326
325. Conidia produced in campylidia 327

326. Apothecia sessile..*Fellhanera* Vězda
326. Apothecia adnate and spot-like..........................*Byssolecania* Vain.
Note: Recent key to species available (Lücking 2008).

327. Apothecial discs black, hypothecium brown, K+ purple..... *Tapellaria* Müll. Arg.
Note: One species known from Thailand: *T. nigrata* (Müll. Arg.) R. Sant.
327. Apothecial discs grayish brown, hypothecium brown, K– .... *Calopadia* Vězda
Note: Recent key to species available (Lücking 2008).

328. Thallus verrucose, conidia non-septate .... *Sporopodium* Mont.
328. Thallus smooth, conidia multi-septate.......................*Lasioloma* R. Sant.
Note: One species known from Thailand: *L. phycophilum* (Vain.) R. Sant.

329. Asci unitunicate... 330
329. Asci bitunicate.. 332

330. Perithecia white to pale pink, photobiont trebouxioid .... *Aspidothelium* Vain.
330. Perithecia yellowish to green, brown or black, photobiont trentepohlioid..... 331

331. Perithecia glabrous or, if hairy, then involucrellum yellowish to brown *Porina* Ach.
331. Perithecia with black hairs or spines, involucrellum mostly pigmented . . . . *Trichothelium* Müll. Arg.

332. Paraphyses absent in perithecia . . . . *Microtheliopsis* Müll. Arg.
Note: One species known from Thailand: *M. uleana* Müll. Arg.
332. Paraphyses present in perithecia. 333

333. Paraphyses unbranched or slightly branched apically, photobiont *Cephaleuros* or *Phycopeltis*. 334
333. Paraphyses branched, photobiont various. 337

334. Perithecial wall not carbonized. . . . . *Puigariella* Speg.
Note: One species known from Thailand: *P. nemathora* (Mont.) S.H. Jiang & al.
334. Perithecial wall at least partially carbonized. 335

335. Thallus supracuticular, photobiont *Phycopeltis*. . . . . *Phylloporis* Clem.
Note: Recent key to species available (Jiang & al. 2020).
335. Thallus subcuticular, photobiont *Cephaleuros* or *Trentepohlia*. 336

336. Thallus olive-brown to dark green, perithecia covered by thin thallus layer around ostiolum. . . . . *Racoplaca* Fée
Note: Recent key to species available (Jiang & al. 2020).
336. Thallus bright green to grey-green, perithecia black, not covered by thallus . . . . *Strigula* Fr.

337. Pycnidia setose, conidia in rectangular packages. . . . . *Caprettia* Bat. & H. Maia
337. Pycnidia globose to conical, conidia in irregular masses . . . . *Anisomeridium* (Müll. Arg.) M. Choisy

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